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EXPANDED TECHNICAL ASSISTANCE PROGRAM

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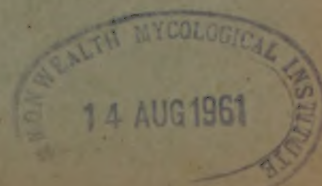
on

PLANT PROTECTION



FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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REPORT
to
The Government of Israel
on
PLANT PROTECTION

by
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INTRODUCTION

In accordance with the terms of an agreement (No. TA - 281/5/9) signed December 1951, between the Food and Agriculture Organization of the United Nations and the Government of Israel, an FAO plant protection expert was to visit Israel "to advise and assist the Government on matters relating to insect control." The FAO expert Dr. Marcovitch was in Israel from June 1952 until the end of May 1953.

While in Israel the expert worked in close collaboration with the Ministry of Agriculture and the Division of Plant Protection which concerns itself with both plant pathology and entomology. Conferences were held with staff members and many field trips were made to acquire first hand knowledge of existing plant-protection problems.

Appreciation must be recorded for the assistance provided by many government officials with a special word of thanks to Dr. I Peretz for personally undertaking to conduct the expert on numerous field trips.

The State of Israel is undergoing a rapid growth and development. The introduction of new plants in new areas, and the intensive system of agriculture demands a ready solution of the insect problems that are constantly arising.

The country is small with a wide variety of climatic factors.

The summer months are dry but rain falls during the winter months. The Jordan Valley is tropical, the coastal plains subtropical and the mountainous areas temperate.

Citrus is the major exportable asset of Israel and before the war there were 75,000 acres. The most important insects of citrus are the Florida Red Scale Chrysomphalus aonidum (known locally as the black scale); the citrus rust mite, Phyllocoptruta oleivora, and the Mediterranean Fruit Fly Ceratitis capitata. Scale insects are well controlled with highly refined petroleum oil sprays, while the citrus rust mite is satisfactorily controlled by sulphur dust.

PRESENT INVESTIGATIONS

Mediterranean Fruit Fly

The control of this pest is still an unsolved problem although considerable progress has been made this past year. The presence of this insect limits the production of oranges to the winter months when the fly is usually not active. During the season of 1952-53, a large-scale field experiment was financed by the Citrus Board and carried out under the direction of Dr. A. Grunberg. The insecticide formulations tested at Ein-Harod, Nes-Ziona, Ramleh and Chazor were (1) Methoxy Emulsion, (2) Methoxy Suspension, (3) DDT Emulsion, (4) DDT Suspension, (5) Dieldrin Suspension, (6) Lindane Suspension.

In all the treatments, the insecticides were applied at the rate of 2 kg. per dunam ($\frac{1}{4}$ acre) in 100 litres of water. At Ein-Harod Methoxy-Suspension was applied by airplane. Treatments were applied the first week in October and at Chazor, a second application was made October 16. As a check on effectiveness, fallen fruit under 40 trees in each plot was counted.

Biological tests were carried out by the FAO expert to determine the toxicity of spray residue on leaves. For this purpose, mosquito (*Aedes aegypti*), adults of *Drosophila* and *Calandra* were employed. Samples of leaves were collected at various intervals in orchards sprayed October 1952 and brought to the laboratory. From each sprayed plot five square inches from five leaves were used and placed in cups with fifty cc. of water. The water was stirred a few times and after ten minutes, the leaves were removed and mosquito larvae added. Observations were then made as to the time required for mortality. From leaves collected 6 November, the Lindane was no longer toxic. Dieldrin and DDT suspension showed 100 percent kill in twenty four hours, while Methoxychlor gave only sixty percent kill.

Table I - TOXICITY TESTS TO AEDES AEGYPTI

<u>Insecticide</u>	<u>Percent dead in 24 hrs.</u>	
	<u>Nov. 6</u>	<u>Dec. 10</u>
1. Dieldrin	100	100
2. DDT E	60	70
3. DDT S.	100	0
4. Methoxy E.	60	0
5. Methoxy S.	60	50
6. Lindane	0	0

By 10 December, Dieldrin was still very toxic with one hundred percent kill. DDT emulsion gave a kill of 70 and methoxy suspension 50 percent.

Tests were also conducted to determine the toxicity of the pure materials themselves. Methoxychlor wettable powder was toxic to mosquito larvae at a dilution of 1 to 20,000,000 while Dieldrin gave a kill at 1 to 500,000,000.

Field Observations in 1952-53

The week of December 3 - 9 was very warm and resulted in a rapid build-up of the fruit fly. At Lydda, some of the trapping bottles had as many as 200 flies per bottle. South of Rehovoth, flies were present in injurious numbers, and in the latter part of December much of the fruit was already infested. At Chazor, where one of the experimental orchards was located, there was a large amount of oranges and grapefruit on the ground, perhaps half of the crop in the untreated plots. In the sprayed plots, there was no fruit on the ground and very few stings were observed. Many of the oranges in the check plot had as many as twelve stings or egg-laying punctures, and full-grown larvae were also present in the grapefruit. Due to the unusually warm season, many of the orchards were heavily infested by the fly. In a normal year, flies are not present in December. Under heavy fly populations as in the present season, the growers would like to apply control measures, but there are not enough sprayers in the country to cover the orchards in a week or two. If enough planes were available, a 50 percent wettable powder could be applied within a few days to most of the orchards. However, more data must be obtained with dusts and sprays applied by airplane, and every effort must be made to determine the effectiveness of these applications in emergencies, when the flies are threatening.

Results

On October 6, 1952, Methoxychlor emulsion was applied at Chazor at the rate of two kilos per dunam ($\frac{1}{4}$ acre). Counts were made as to the number of oviposition punctures on 33,800 fruits. One of the plots received two treatments in the fall, and one plot received one treatment in the fall and one treatment in the spring.

As noted in the Table II, excellent results were obtained. Dieldrin showed up better than Methoxychlor. The best results were obtained with Lindane, there being only .16 percent infestation. These tests will have to be repeated next year, since, in the biological tests, Lindane was not as good as Dieldrin. The problem of off-flavoring of fruits and vegetables caused by the use of BHC and Lindane also needs further study.

TABLE II - RESULTS OF TREATMENTS AGAINST THE MEDITERRANEAN FRUIT-FLY
AT CHAZOR WITH METHOXYCHLOR EMULSION

<u>No. of treatments</u>	<u>No. of fruits examined</u>	<u>Percent infested</u>	<u>Percent in check</u>
2 (in fall)	33,800	.41%	81.7%
1 (in fall)	13,000	8.17%	81.7%
2 (one in fall one in spring)	13,000	2.65%	71.7%

At Nes-Ziona (1 treatment)

Material

Methoxychlor emulsion	13,000	.41%	12.5%
" suspension	13,000	.45%	12.5%
Dieldrin "	13,000	.21%	12.5%
Lindane "	13,000	.16%	12.5%

The fruit-fly is not a limiting factor any longer

Heretofore the fruit-fly was a limiting factor in the production of citrus in Israel, especially in warm winters, and on late varieties such as the Valencia. The results of the experiments as shown in Table II indicate that the use of such insecticides as Methoxychlor or Dieldrin may prove very effective. The growing of late varieties such as Valencia, therefore, can be encouraged. This will extend the shipping season, and make the production of citrus fruits more profitable.

The importance of fumigation

Recent tests using ethylene dibromide (7 grams per cubic meter) as a fumigant have given excellent results in the control of the larvae in the fruit, giving 98 percent control. Nitrogen trichloride for the control of diseases when mixed with ethylene dibromide increases the effectiveness of the fumigant. Fumigation of 100 boxes of fruit would cost only about one half pound (Israel), while spraying an equal quantity of fruit on the trees would cost ten pounds. These figures show that fumigation is much more economical than spraying. Another weapon in the control of the fly, especially for the export trade, is thus provided. Fumigation, however, cannot replace spraying for the control of heavy infestations.

Olive Fly (Dacus oleae)

The olive fly is another fruit-fly for which control measures are yet lacking. Olives are an important crop and at present 150,000 dunams are grown, mostly in the hill country. The early large fruited varieties such as "Merchavia" are more readily attacked than the small fruited "Souri".

Experiments were carried out by Dr. Peretz in 1951 with:

1. 5 percent DDT + 2 percent molasses
2. 5 percent Methoxychlor + 2 percent molasses
3. Dieldrin .3 percent.

Each tree received 20 litres of spray material containing 50 grams of active ingredients, except Dieldrin which contained 15 grams. Four treatments were given beginning the first week in June. The results of these treatments were encouraging.

Sugar Beet Weevil, (Lixus juncii)

This insect is one of the limiting factors in the cultivation of sugar beets in Israel. In some years, the damage may be as high as fifty percent with an average of twenty percent. In 1952, larvae, pupae and adults were abundant in July in the Huleh area. The larvae frequently cause a rot to develop in the beets, while the adults attack the leaves which wither and fall to the ground.

The beetle has been known as a pest of fodder beets for many years. The second generation is particularly injurious in the month of July. At present, studies are being made on the biology and life history.

From some previous experimental work, there are indications that benzene-hexachloride ($\frac{1}{3}$ percent of $6\frac{1}{3}$ percent gamma) is an effective insecticide and tests will be made with this material in the coming season. For the first generation, the treatments will be made in the middle of February and for the second generation, about the middle of June.

An interesting development is the growing of sugar beets in the fall and winter on land that is used for fish ponds in the summertime. The sugar beets make a wonderful growth on the fertile soil that is completely free of weeds. Frequently these beets will be attacked by Prodenia litura or Agrotis, and the question comes up as to the effect of DDT or other insecticides on the growth of fish. It appears that Cryolite would be a safe insecticide. The waters in Israel have a high calcium content and the formation of calcium fluoride would tend to neutralize any toxicity from the cryolite residues.

Prodenia litura

This insect is one of the more injurious pests in Israel. It attacks a wide variety of crops including many legumes, potatoes, sugar beets, cotton, flowers and many plants in nurseries. A ten percent sodium fluosilicate bait or a cryolite dust will give control if repeated two or three times. The past year, a three-tenth percent Dieldrin spray of a 50% wettable powder gave excellent control on beans and peanuts when used at the rate of 600 grams per acre. Heavy infestations required two treatments.

Spiny Boll Worm (Earias insulana)

Cotton is not growing commercially at present in Israel. In an experimental patch, this insect proved to be a major pest, destroying about ninety percent of the squares and bolls.

During the current season it is planned to try out Endrin which has been reported to be very effective in Iraq, when used at the rate of $\frac{1}{4}$ to $\frac{1}{2}$ pound per acre.

Oriental Hornet (Vespa orientalis)

One of the most destructive insects in the Middle East is the Oriental hornet. It attacks grapes, and some vineyards suffer as much as fifty percent damage. In apiaries, it kills bees and entire apiaries have been known to be destroyed. It also injures dates, and other fruits. Young trees are frequently badly damaged through the destruction of the bark. Mr. Raskin has been appointed to cope with this pest and to advise farmers in methods of control. The Israeli expert recommends that the queens be caught and killed in the spring. Calcium cyanide is used for the control of hornets in their nests in the ground. Trapping or a bait composed of meat and thallium sulfate is also advised.

Grape Insects

The two most important insects attacking grapes are the grape berry moth (Pelychrosis botrana) and the grape mealy bug (Pseudococcus citri). The presence of these pests forces early harvest and thus reduces the sugar content. The work of Dr. I. Peretz showed that they could be controlled by treatments with "Kryocide" and DDT.

The best results were obtained with one application of Kryocide using one and one half kilos per dunam and two applications of DDT.

These treatments gave 97 percent clean fruit, while the checks had only 24 percent. At harvest time, there was .8 p.p.m. of fluorine present and .3 p.p.m. of DDT. Where mealy bugs were present they were controlled by parathion.

The control of these pests enabled the growers to harvest the grapes three weeks later, and resulted in an increase of sugar content from 18 to 24 percent.

Stored Grain Insects

The work on stored grain insects is being carried out by Mr. Kalderon. At the present time, he is making a survey of the various insects attacking the grain in storage on the farm. The most abundant insects present are Calandra oryzae, Rhizopertha dominica and Tribolium confusum. Trogoderma granarium is also present in serious numbers in the Jordan Valley. The various methods of grain storage are being studied and when feasible, fumigation with ethylene dibromide at the rate of 80 - 100 grams per cubic meter is being recommended. Where proper control measures are not taken, the damage may frequently amount to thirty percent. Birds such as the starling also cause considerable damage by eating the grain and tearing the sacks.

Fig Borer (*Batocera rufomaculata*)

This species appears to be a new pest for Israel and was found by Dr. Bytinski in the Haifa area in 1951. It is a very large insect, the adult beetle being over two inches long. The larvae live in the trunks of the fig tree, feed on the cambium, and eventually kill the tree. This insect probably came to Israel from Africa, where it feeds on Mango and a large number of other trees.

Mole Crickets (*Gryllotalpa gryllotalpa*)

A very heavy infestation of mole crickets was found at Kfar Azar on 2 December 1952. Potatoes were completely destroyed and lettuce and spinach were badly damaged. For control, two percent of Aldrin was applied by Dr. Peretz at the rate of ten kilos per dunam and worked into the soil. An examination on 23 December showed that the Aldrin gave excellent control. Some of the plots were so heavily infested that two applications were necessary for good control. BHC was not so effective as Aldrin.

OTHER INSECT PESTS OF IMPORTANCE

Codling Moth (*Carpocapsa pomonella*)

Due to the warm climate, there are five or six generations of codling moth on apple. In order to keep this pest in check, eight to ten treatments of DDT and Kryocide are required at ten to fourteen day intervals. The use of DDT, however, often results in a mite problem for the control of which sulphur is used. Aramite will be given a test this summer for the red spider mite.

The Leopard Moth (*Zeuzera pyrina*)

This insect is a serious pest of apple and olive trees. Mechanical methods such as inserting a wire in the tunnels are used in its control. Sprays of Kryocide at the end of the summer are also effective.

Capnodis spp.

In previous years, Capnodis was a limiting factor in the production of stone fruits, by girdling the trees. The adults can be effectively poisoned by spraying with Kryocide during the months of April to July.

The "Blue" (*Virachola livia*)

This insect can do considerable damage to pomegranites in certain areas by boring into the fruit. A timely spray of Kryocide or DDT is effective.

False Wireworm (*Cardiophorus ruficoes*)

This insect is frequently injurious on new land. It attacks both the planted seeds and roots of cultivated plants. Soil treatments with B.H.C. and Aldrin are employed. Aldrin appears to be more advantageous since it does not injure plants.

Noctuid Moths (Cutworms)

Several species such as Prodenia litura, Chloridea obsoleta and Agrotis ypsilon are at times destructive to vegetables and field crops. For their control, baits of sodium fluosilicate are used as well as sprays and dusts of dieldrin.

Aphids

Aphids of various species become troublesome at times. Nicotine products are used for their control.

Thrips

Two species of thrips, Retithrips syriacus and T. tabaci attack avocado, mango, vegetables, grapes and ornamentals. Good control has been obtained by the use of Chloridane or Dieldrin.

Rodents

Nicrotus guentheri and Meriones shawi are very destructive in some years. In 1950, over 30,000 hectares were overrun. Wheat poisoned with thallium sulfate gave good control.

ORGANIZATION OF PLANT PROTECTION IN ISRAEL

Prior to 1948, pest control was a branch of the agricultural department of the British mandatory government. The entomological section was concerned mainly with the insect problems as they arose under field conditions. Some attention was also given to plant quarantine.

Upon the establishment of the State of Israel in 1948, a ministry of agriculture was established which included the following divisions: field crops, horticulture, water engineering, animal husbandry, fisheries, soil conservation and plant protection.

Dr. Jacob Peleg, a recognized plant pathologist of long experience was placed in charge of the division of plant protection. Dr. Peleg organized the division along the following lines: a section devoted to insect control; a section for phytopathology; rodentology; weed control and taxonomy.

In the entomological section, there is an entomologist stationed at Haifa, to look after the insect problems in the northern section of the state. At Jaffa where the main office of the division of plant protection is located, there is one entomologist in charge of the work for the central part of the state and one for the southern. There is also an entomologist in charge of citrus insects, one for hornets, and one in charge of stored grain insects. A very able taxonomist who serves the whole division in insect identifications is organizing an extensive and useful collection of insects.

A chemical laboratory has been added for analyzing various insecticides, making residue analyses and proper formulations.

DEPARTMENTAL ACTIVITIES

Insecticides

Special attention is being given to the evaluation of the new (the chlorinated hydrocarbons) insecticides such as Aldrin, Dieldrin, Endrin, Chlordane, Heptchlor, BHC, Lindane and Methoxy, DDT. The miticide Aramite is being tested. Among the organic phosphates, parathion, malathion and such systemics as Systox, are being investigated.

Aldrin has been found especially valuable as a soil insecticide for the control of mole crickets and false wireworms; while Dieldrin has given excellent results against prodenia and various thrips.

Among the fluorine insecticides, Kryocide is very popular against a wide variety of fruit and garden insects. There is now being used about 600 tons annually. Both sodium and barium fluosilicate are used in bait formulations for cutworms and army worms.

The arsenicals are little used and are being replaced by DDT, BHC, and Kryocide.

Ethylene dibromide is extensively used for the fumigation of citrus fruit and of stored grain insects. It was recently found that fumigated grain affected poultry adversely if used too strongly, and this problem is being studied.

Insecticide supplies

Over three million dollars worth of insecticides are now imported. This large amount is necessitated by the intensive growing of fruits and vegetables which suffer from insect pests. In order to economize on the cost of insecticides, concentrates are imported whenever possible. A seventy-five percent DDT, for example, can be diluted to a 5 percent material with Kaolin which is obtained locally in the Negev.

There are now two plants that are equipped to make any formulation that entomologists may advise.

Plans are under way in Israel for the manufacture of insecticides, such as benzene hexachloride, from chemicals that are produced locally. This should help to give farmers cheaper insecticides.

The sale of insecticides is controlled by the government, in order to standardize as far as possible the various formulations at reasonable prices. Efforts are also being made to acquaint farmers, especially the new immigrants with those insecticides that are poisonous so as to avoid any hazards.

Spray Machinery

Considerable attention is being given to spray and dust machinery and methods of application. More particularly, mist sprayers and low volume machinery are being tested for insect and weed control. Due to the semi-arid conditions in many places, low volume applications are of special importance for the saving of water, labor and insecticides. A few piper cubs and Steerman's are available for airplane dusting and spraying.

Educational Work

In order to reach as many farmers as possible, leaflets on various pests are prepared in Hebrew and distributed. Timely articles are also prepared for various farm papers and special talks are made over the radio on insect conditions.

Insect Identification

Large numbers of requests come to the department for the naming and identification of various insects. For this purpose, the division employs a very able taxonomist with a recognized reputation in his chosen field. Where more information on the biology and life history of an important insect pest is desirable, studies (along these lines) are initiated.

Locusts

There is at present a threat of locusts invading Israel from Transjordan and Saudi Arabia. To cope with this threat a good organization has been set up in various parts of the State. A supply of insecticides, such as BHC and Chlordane has been placed in five different areas together with spray and dust machinery. In each area there is an administrator in charge for informing the farmers on control methods. At present only a few small swarms have been found, but the danger of invasion still exists.

COORDINATED RESEARCH PROGRAM

The existing zonal scheme of the Plant Protection Division appears to have certain advantages and has answered the purpose for the time being, by meeting the needs of the farmers in the form of extension work. Attempts are also made to solve some of the problems where no information is available by carrying out a certain amount of experimental field control work. However, under the existing organization there is no well-coordinated research program.

There is a need for more information on the Lixus beetle of sugar beets and other pests in order to devise effective control measures. This new information can be obtained only by constant research performed by capable men well trained in research methods and belonging to a central organization of applied research. In order to increase the effectiveness of pest control work it is recommended that the Central Bureau of Plant Protection be organized to replace the existing zonal plan.

Under the present organization the entomologists located at Rehovoth are adequately prepared to undertake long range fundamental research that is not necessarily of immediate practical importance. Their work would include studies in the ecology and life history of insects.

RECOMMENDED ORGANIZATION OF PLANT PROTECTION

Bureau of Plant Protection

1. Department of Applied Research.

- (a) Division of Fruit Insect Investigation
- (b) " " Truck Crop Insect Investigation
- (c) " " Field " " "

2. Department of Extension.

Applied Research

The applied research having to do with the practical control of insects in the field is to be performed by the department of applied research. Their duties will comprise the gathering of data on spray machinery, the evaluation of insecticides, dosage, timing of applications, and evaluating the extent of injury. Drawing the proper conclusions from statistically accurate data will naturally be most essential.

In order to carry out the program of field control of insects, the appointment of a "Director of Field Research in the Control of Insects" would be desirable.

The various lines of research work should be outlined in the form of projects and a leader should be appointed for each project. This arrangement places the responsibility for each project on the leader, who is to select his assistants in carrying out the project.

Experiment Station

For best results, the agricultural experiment station should have its own farm where experimental plots can be laid out in accordance with the demands of the research problem. Since no such land is available at Rehovoth at the present time, the good will of the farmers or special appropriations and special budgets, which are not always forthcoming, must be depended upon. Mr. Carmon, horticultural specialist, Ministry of Agriculture, is working on a plan to obtain land for an experimental farm. Mr. Carmon's efforts should be encouraged and his plans be given careful consideration.

Department of Extension

For most effective service to the state it is desirable to have a separate personnel to carry out the extension work. Since this is not possible at present, it is proposed that the men in the Bureau of Plant Protection devote approximately 40 percent of their time on research problems and 60 percent on extension work. The extension work will consist mainly in keeping the instructors and farmers informed of the latest developments. The instructors' work in Israel is somewhat comparable to the county agent system in the United States.

The extension service will keep the instructors informed:

1. By issuing a monthly letter on timely information for the control of insects.
2. By a bi-monthly meeting to inform and teach them the use of insecticides and new equipment.
3. By semi-annual meetings with the farmers in different areas of the state.
4. By publicity through the newspapers and radio when the occasion arises.

Every effort should be made to consider the recommendations as issued by the plant protection service as standard. Instructors and others are not to be permitted to develop their own program but must follow the standard recommendations of the plant protection service.

Additional Personnel

It is desirable to point out that an under-study to Dr. Peleg should be appointed. At the present time he is responsible for the organization and leadership of all research activities, as well as administration of the Division of Plant Protection. This is too great a burden for Dr. Peleg, and prevents the full use of his talents.

It would be highly desirable also to have several more young men as assistant entomologists, so that they can be trained to carry on and grow with the department.

Fellowships

Fellowships abroad would be desirable in order to broaden the viewpoint of the entomologists. In this connection it is recommended that F.A.O. be approached to provide fellowships; however, in view of the pressing demands on FAO funds it might be well to make other arrangements for the provision of these fellowships.

Plant Quarantine

There is constant danger of the importation of new pests in the State of Israel. In order to prevent the entry of plant pests, all plants and nursery stock shipped into the state must be inspected by competent men. For this purpose, the plant quarantine service of the Division of Plant Protection has been stationed at Haifa and Lydda. Their job is to destroy, disinfect or fumigate all suspicious material.

Quarantine is assuming ever increasing importance with the continued increase of travel, and interceptions of prohibited material are increasing at the ports. The value of this service to the country is self evident and should be well supported. If one seriously dangerous pest, such as the Oriental fruit fly or the Colorado potato beetle can be kept out, the service will more than pay for itself.

Nursery Inspection

There is not only danger of the importation of new pests in the country, but it is equally important to guard against the spreading of pests from one part of the state into another through the shipment of nursery stock, seeds and fruits. The nursery inspection service has the function to prevent the spread of pests within the state, or from one locality to another.

All plant material intended for propagation should be inspected at the ports of shipment or destination. A strong regulatory service to prevent the spread of pests is now a necessity in all progressive countries.

Fumigating Chamber

At the present time no facilities are available for fumigating plants or fruits that are shipped to Israel. Dangerous insect pests may thus be introduced into the country. A fumigating chamber built in the harbor at Haifa in order to minimize the introduction of dangerous pests would be very desirable.

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